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essentially different curves representing heat and light must be banished hereafter from text-books. The old views on this subject can no longer be maintained even by European men of science, who are prepossessed in their favor. This result, fulfilling what was almost a prophecy when made, a quarter of a century ago, by the elder Draper, and, being due largely to means which science owes to Mr. Rutherford, may, if obtained, be most fairly claimed as largely due to the two Americans whose names have just been cited.

## ON THE INTIMATE STRUCTURE OF CERTAIN MINERAL VEINS.\*

PROF. BENJAMIN SILLIMAN.

Dr. Sorby, of England, in his classical paper "On the Cavities and Fluidal Inclusions found in Certain Varieties of Quartz," made the sagacious suggestion that certain fluidal inclusions observed by him in quartz consisted of two fluids, viz., water and probably a liquified gas also. An examination has recently been made of a remarkable vein stone from a gold vein now known as "Hunter's Rest," Arizona. This vein was capped by a black uncrystalline rock resembling somewhat hornblend in a compact form. But it was seen under the microscope with polarized light to be compact tourmaline, a mineral never found associated with gold. This black rock which is common enough in connection with tin ore, is here abundantly coated with gold. But beneath this black capping at a very moderate depth, occurs the usual quartz filling of gold-bearing veins—the quartz in this vein showing free gold in brilliant points, and stains of copper green with some pyrite, galena, etc. This quartz seen in thin section under a high power, showed a multitude of fluidal cavities, and among them were some which under a high power ( $\frac{1}{2}$  to 1-15-inch) showed distinctly two fluids, one of which existed as an inner bubble, and which displayed almost constant activity of motion. This second liquid was liquified carbonic acid. Thin sections of the vein-stone were placed upon a slide for examination. When warmed, the carbonic acid expanded and the motion ceased, but when permitted to become cold, it became as active as before. Quartz with gold found in Southern California near the Nevada line, is entirely destitute of sulphurets, showing that the intervention of iron salts as a solvent agent was not necessary in the formation of the deposits of gold.

## THE TURQUOISE OF NEW MEXICO.\*

PROF. BENJAMIN SILLIMAN.

A number of domestic articles have recently been found in excavations at Mount Chalchuitl, in Los Cerillos, about twenty-two miles southwest of the ancient town of Santa Fe. Among these are a large stone hammer of the hard hornblendic Andalusite of which the mountains of the country are largely formed; a lamp, a pottery idol, such as are manufactured to this day; a spoon made of shell; a perfect specimen of a pottery dish, and some of the bones of the Pueblos or Indian miners, who were killed in 1680 by the fall of a large section of Mt. Chalchuitl, which had been undermined by them. These articles had been covered in the caverns for 200 years when found. The rocks which form Mt. Chalchuitl—the Indian name of the turquoise—are distinguished from those of the surrounding and associated ranges of the Cerillos by their white color and decomposed appearance, closely resembling tuff and kaolin, and giving evidence of an extensive and profound alteration, due, probably, to the escape through them, at this point, of heated vapor of water and perhaps of other

vapors or gases, by the action of which the original crystalline structure of the mass has been completely decomposed or metamorphosed, with the production of new chemical compounds. Among these the turquoise is the most conspicuous and important. In the seams and cavities of this yellowish-white and kaolin-like tuffaceous rock the turquoise is found in thin veinlets and little balls or concretions called "nuggets," covered on the exterior with a crust of the nearly white tuff, and showing on cross fracture the less valued varieties of the gem, more rarely offering fine sky-blue stones of higher value for ornamental purposes. It is easy to see these blue stains in every direction among these decomposed rocks, but the turquoise in masses of any commercial value is extremely rare, and many tons of the rock may be broken without finding a single stone which a jeweller or virtuoso would value as a gem.

That considerable quantities of the turquoise were obtained can hardly be questioned. The ancient Mexicans attached great value to this ornamental stone, as the Indians do to this day. The familiar tale of the gift of large and costly turquoise by Montezuma to Cortez for the Spanish crown, as narrated by Clavigero in his history of Mexico, shows the high value attached to this gem. It is not known that any other locality in America has furnished turquoise in any quantity. The origin of the turquoise of Los Cerillos in view of late observations is not doubtful. Chemically, it is a hydrous aluminum phosphate. Its blue color is due to a variable quantity of copper oxide derived from associated rocks. The Cerillos turquoise contains 3.81 per cent. of this metal, neglecting this constituent the formula for turquoise requires: phosphoric acid, 32.6; alumina, 47.0; water, 20.5. Total, 100.1. Evidently the decomposition of the feldspar of the trachyte has furnished the alumina, while the phosphate of lime, which the microscope detects in the thin sections of the Cerillos rocks, has furnished the phosphoric acid. A little copper is diffused as a constituent also of the veins of this region, and hence the color which the metal imparts. The inspection of thin sections of turquoise by the microscope, with a high power, shows the seemingly homogeneous mass of this compact and non-crystalline mineral to consist of very minute scales, nearly colorless, and having an aggregate polarization, and showing a few particles of iron oxide. The rocks in which the turquoise occurs are seen by the aid of the microscope and polarized light in thin section to be plainly only the ruins, as it were, of crystalline trachytes showing remnants of feldspar crystals, decomposed in part into a white kaolin-like substance, with mica, slag and glassy grains, quartz, with large fluidal inclosures, looking like a secondary product. There is a considerable diversity in their looks, but they may all be classed as trachyte-tuffs, and are doubtless merely the result of the crystalline rocks of the district along the line of volcanic fissures.

## ON A NEW GENERAL METHOD OF ANALYSIS.\*

BY PROF. WALCOTT GIBBS.

The process consists essentially in passing a galvanic current through the solution in such a manner that a surface of metallic mercury forms the cathode, and a plate of platinum the anode. Under these circumstances the metal in the solution combines with the mercury to form an amalgam. What is new in this process is the fact that a number of metals, as for example, iron, cobalt, nickel, zinc, cadmium, tin, mercury, etc., may be *completely* removed from the solution so that the electro-negative constituent of the roll may be determined in the solution by ordinary methods, while the metal itself is found by the increase in weight of the mercury. The extent of the applications of the method and its limitations remain to be determined.

\* Read before the National Academy of Sciences, N. Y., 1880.

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